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PSYCHROMETRIC WET-BULB WATER SUPPLY SYSTEM

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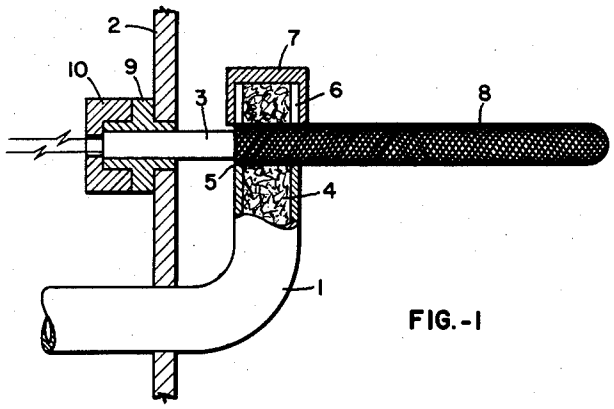


FIG.-1

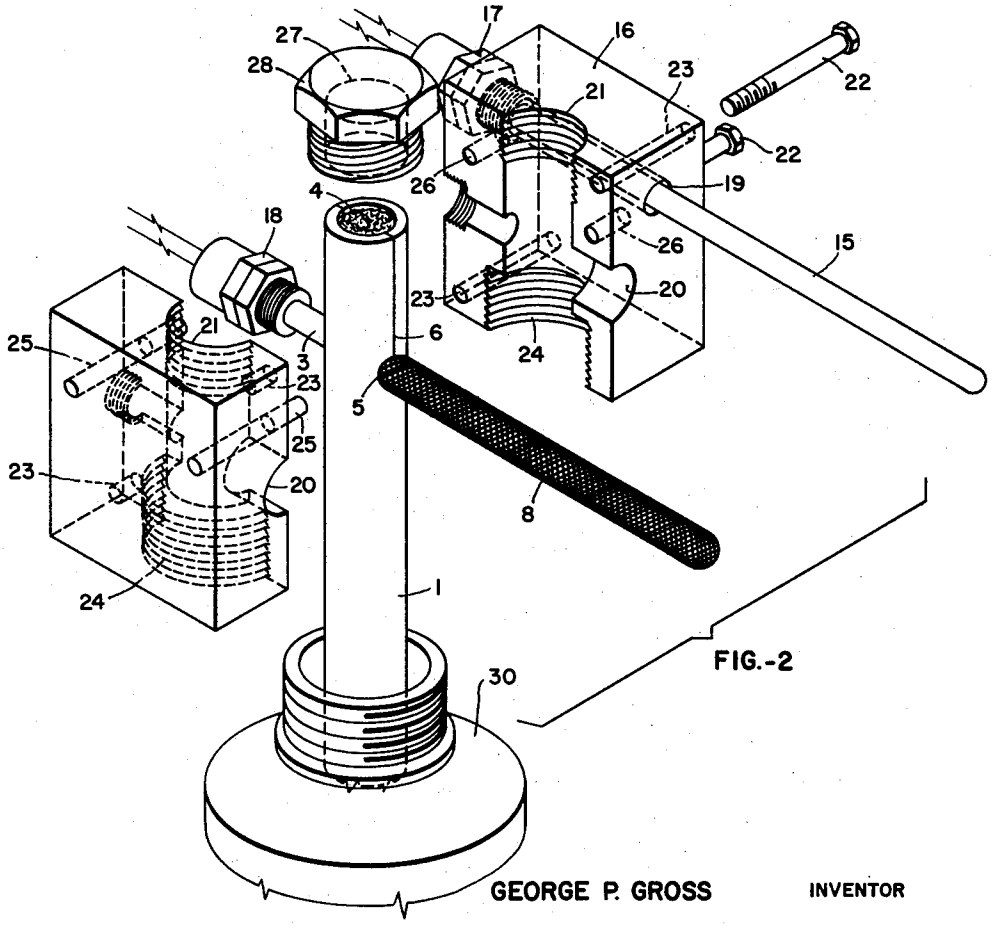


FIG.-2

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PSYCHROMETRIC WET-BULB WATER SUPPLY SYSTEM

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This invention relates to an improved means and method for continuously supplying water to the wet-bulb element of a psychrometric system of the wet-bulb/dry-bulb type. Such a system may indicate and/or control (with suitable auxiliary equipment) the wet-bulb and dry-bulb temperatures, and thus indicate and/or control the humidity of a stream or body of air.

The wet-bulb element of a psychrometric system functions by the cooling action imparted to a thermal sensing element through the evaporation of water from its surface into a moving air stream. The dry-bulb element, having no evaporative cooling, senses the true air temperature. The two temperatures which these elements measure define precisely the absolute or relative humidity of the air stream.

Means for evaporative cooling of the wet-bulb thermometer is universally provided by a sleeve-type fabric wick or by a porous ceramic tube surrounding the sensitive element of the thermometer. The fabric wick may be a snugly fitting woven or knitted tube which may be slipped over the sensing element of the thermometer. In place of a fabric wick, some prior art systems employ a fine metallic tubular meshed sleeve. No matter what type porous material is used, evaporation from the wick or tube cools the enclosed thermometer. Water is customarily supplied to the wick or tube by various methods. In one such method, a wick extends beyond the wet-bulb thermometer end to a more or less remotely located water reservoir and water is absorbed by capillary action to the point where cooling is desired. Water in the reservoir is either replenished periodically or maintained by a level control system from an external source. In another method, a continuous water flow rate to the wick may be maintained by various methods of controlling the fluid head, together with a throttling orifice to control the flow of water under the constant head.

In the past, much difficulty has been encountered in keeping the wick of the wet-bulb thermometer properly moistened. An improperly moistened wick causes errors in the measuring and/or controlling of the air temperature and humidity. The prior art methods of supplying water to the wick of the wet-bulb thermometer have various shortcomings. In the trailing wick system there is a substantial amount of wick used to connect the functional end of the evaporating surface to the water reservoir. This results in water losses that have no bearing upon the objectives desired. In fact, both excessive use of water, which is necessarily of high purity, and a fatal tendency to plug with deposits in spite of pure water result. In addition, the wick-connected reservoir and thermometer may, in some cases, be awkward and not sufficiently portable to be easily installed in the desired location, such as in an air duct or air cabinet. The constant flow system usually entails some metal parts which corrode and cause the wick or sleeve to plug with metal salts, resulting in malfunctioning. In addition, this type system is suited only to a fixed evaporation rate from the active area. Thus, changes in air flow rate past the wick or changes in air humidity result in either an inadequate water supply for a higher demand or in a constant drip of liquid water from the wick because of excessive water supply.

No matter what system is used to supply water to the wet-bulb element, there exists the problem of wick plugging at the point where the wick is in contact with the air stream. In spite of the use of water of high purity in conjunction with clean wicks or tubes, it is commonly observed in the maintenance of psychrometers that deposits occur in the evaporating element and require its periodic replacement or cleaning. Preferably, this should require changing of the evaporating element only and not of an associated water transporting element. Deposit formation is a consequence of (1) evaporation and (2) deposition from the incident air stream. When water of high purity is used, deposit formation is not a consequence of water transport. Therefore, it is preferable to shield the transporting element from the air stream and expose only the functional or evaporation surface of the wet-bulb element.

It is an object of the present invention to overcome the above described difficulties. It is another object of this invention to provide an improved wet-bulb water-supply system for psychrometers. It is still another object to provide a compact, easily portable psychrometric system. Further objectives will become clear in the discussion that follows.

The nature of the present invention is best understood when described in connection with the accompanying drawings in which FIGURE 1 is a side elevation view, partially in cross section, showing the wet-bulb water-supply system of the instant invention installed in an air duct, and FIGURE 2 is an exploded perspective view of one embodiment of the present invention.

Referring to FIGURE 1, it is seen that the present invention consists of a tubing **1** of suitable length to extend from a convenient water supply (not shown) to the wet-bulb element **3**. The tubing is filled through its length with a material **4** providing a plurality of capillary passages. The tubing is drilled or bored transversely across its axis near the wet-bulb end with a hole **5** of sufficient size to permit passage of the wet-bulb thermal sensing element **3** in a direction normal to the axis of the tube. The tube is slit **6** longitudinally on both sides from this transverse hole to its proximal end. Slit **6** facilitates assembly of the device and the periodic replacement or repair of element **3** and porous sleeve or wick **8**. The proximal end is closed by a cap **7** which surrounds the tube and holds it together while sealing it against evaporation. The wet-bulb thermal sensing element **3** in a porous sleeve or wick **8** is passed through the hole **5** such that it extends into the air stream. FIGURE 1 shows the wet-bulb water-supply system of the present invention installed through the wall **2** of an air duct. The system is fastened to the wall **2** by any suitable fastening means such as fitting **9** provided with end cap **10**.

The tubing employed may be of any material that is flexible and substantially inert. Thus plastic (e.g. Teflon, Tygon, etc.) or rubber tubing may be used. A preferred tubing is made of a clear plastic. The material used to transport the water by capillary action may be any suitable packing material providing the necessary passageways, such as a plurality of natural or synthetic fibers, e.g. nylon fibers or glass wool, or a mass of porous material such as surgical cotton, or the like. Porous sleeves or wicks which may be used to cover the wet-bulb sensing element include those made of woven or knitted fabric, ceramic, and fine metallic mesh.

The thermal sensing element (thermometer) employed in this system may consist of any of the various types including mercury in glass, liquid-, gas-, or vapor-filled bulbs, thermocouples or thermistors.

Referring to FIGURE 2, a preferred embodiment of this invention consists of wet-bulb **3** and dry-bulb **15** thermal sensing elements maintained parallel and ad-

jacent to each other in an approximately cubical, vertically divided and reassembled block **16**, which is designed for easy disassembly when required. It is of course not essential that this block be cubical in shape.

Elements **3** and **15** are fastened to block **16** by any suitable fastening means such as threaded ferrules **17** and **18** and pass through holes **19** and **20** respectively. Holes **19** and **20** are of sufficient diameter to provide small annular spaces between block **16** and elements **15** and **3** respectively. Block **16** is further provided with a hole **21** of suitable diameter such that when block **16** is assembled there is a small annular space between tube **1** and block **16**.

The annular spaces between the block **16** and elements **15** and **3** and annular space between the block **16** and tube **1** prevent the block and tube from influencing the sensitivity of elements **15** and **3**. Block **16** is fastened together by any suitable fastening means, such as bolts **22** which fit into holes **23**. Alignment of the block **16** is aided by pins **25** which mate with holes **26**. The block **16** is provided with threads **24** so that it may also function as the screw cap closure for a water reservoir **30** such as a bottle with a threaded neck. One end of the cotton-filled supply tube **1** extends into the reservoir. The other end of tube **1** extends into a hole **27**, bored in threaded cap **28**. This end of tube **1** is provided with slit **6** which facilitates assembly of the device and the periodic replacement or repair of element **3** and/or porous sleeve **8**. Cap **28** seals the end of tube **1** and also supports tube **1** in block **16** and in the axis of hole **21**.

The entire assembly, shown in FIGURE 2, and the water-supply reservoir (not shown) may be installed in an air duct or chamber by any suitable means.

While the above preferred embodiment has the reservoir close at hand, the latter could be located in any convenient remote point. In addition, while the preferred embodiment uses a plastic tube as described above, a modification within the scope of the invention, but with some loss of flexibility may use noncorroding metal such as stainless steel. Thus a vertical cotton-filled pipe might terminate upwardly in a standard pipe cross with a closure plug in the top outlet and the wick covered thermal sensing element extending through to project on its sensitive end into the air stream while being supported from the opposite side of the cross. The pipe cross is, of course, also filled with cotton sufficient to bring water into the sleeve or wick by capillary action. Such a structure, using

standard pipe fittings, needs no illustration since its construction would be obvious from FIGURE 2 and the foregoing description.

While a general description has been given and a preferred embodiment of the present invention has been described and illustrated, it is to be understood that various modifications and adaptations thereof, to different uses may be made without departing from the spirit of the invention and the scope thereof as defined by the following claims.

What is claimed is:

1. An improved wet-bulb water-supply system which comprises (a) a tube provided with a transverse hole adjacent to one end thereof and further provided with a slit extending longitudinally on both sides from said hole to the proximal end of said tube, and a cap closing said proximal end of said tube; (b) packing material filling said tube and providing a plurality of capillary passages therein; (c) a thermal sensing element inserted through said hole; and (d) a porous sleeve enclosing a portion of said thermal sensing element and contacting said packing.

2. An improved wet-bulb/dry-bulb psychrometric system which comprises (a) a block provided with three holes passing therethrough, wherein two of said holes intersect and one of said nonintersected holes is provided with threads enabling said block to serve as a screw cap closure for a reservoir for supplying water; (b) a dry-bulb thermal sensing element inserted through the nonintersected hole; (c) a tube inserted in one of said intersected holes; said tube being provided with a transverse hole adjacent to one end thereof; said transverse hole and said block aligned so as to provide a passageway; (d) packing material filling said tube and providing capillary passages therein; and (e) a porous-sleeve-covered thermal sensing element inserted in said passageway.

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